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## THE INFLUENCE OF PROBLEM BASED LEARNING MODEL BASED ON COLLABORATIV TOWARD STUDENT'S ACHIEVEMENT IN CHEMISTRY

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### Abstract

The effectiveness of Problem Based Learning(PBL) model based on Lesson Study to increase student's achievement in Salt Hydrolysis topic is explained. The research aimed 1) to know the using of PBL model based on Lesson Study is effective in increasing student's achievement in Salt Hydrolysis topic compared with direct instruction model, 2) to know the student acievement will be most improved by using of PBL model based on Lesson Study in Inorganic chemistry topic metallic compounds. The research was conducted in SMA N 15 Medan and department of chemistry medan state university semester academic year 2014/2015. The class was divided into two classes, one was called experiment class in XI IPA-2 and control class in class XI IPA-4. Instrument used is validated by empirical validity and constuct validity and all questions are reliable.

Based on the observation sheet of Lesson Study that was observed at teaching-learning process show that the students less in stay learn with friend (50%) but many students worked together in "U" form seat (83.3%). And the improvement of Generic ability of student that most increasing was obtained that in experiment class is modelling, logical inference and logical frame with average score posttest 85,5.

The hypothesis in this research is tested by using t-test and obtained  $t_{count} = 5.1985$  while  $t_{table} = 1.6684$  at significance level  $t_{0,05}$  and  $df = 72$ ,  $t_{count} > t_{table}$ , so  $H_a$  is received. It proved that student's achievement was taught by PBL model based on Lesson Study is higher than direct instruction model. Increasing of student's achievement was calculated by using normalized gain and the percentages gain in experiment class is 71 % (high categories) and percentages gain in control class is 0,48 or 48%

**Keyword:** Problem based learning, direct instruction, lesson study, student achievement and generic ability

## A. INTRODUCTION

The learning process must be focused on students, how the expressions, the attitude of the students for teaching-learning process, how far the students active and involved in the teaching-learning process. Slameto (2003) explain that one of factors influencing of learning process and learning outcomes is learning method which is used by the teacher. The learning method that used can involve the students actively in learning process.

Teacher is the first person and special in increasing the quality of education. As the main subject in the front line in learning process, so the education and guidance that is given by teacher to the students be who determines in carrying the successful of education (Huda, 2012). For this time, at school, there are many teachers that just focus on the subject matter and the result of learning. They were just bustled in some activity to decide the competence goal that would be achieved, to arrange the material that would be taught, and to design the evaluation (Hamruni, 2009).

Basically, the topics learning in Chemistry have 3 characteristics that is the decomposition of concepts, mathematical calculations, and execution experiments. Problem Based Learning (PBL) is one of a model that can be used in this topic, where in this topic have many discussions and calculations also predict the salt that hydrolyzed.

Boud & Felletti (1991) said that, PBL is away of constructing and teaching course using problem as a stimulus and focus on student activity. The student are expected to have motivation to study, not only just listen and remember but also trained to explain their explorer another and trained to solve the problem when they learn chemistry. In PBL, students are trained in develop their skills include asking the questions, answer the questions, active listening, communicate ideas/opinions, being in the task, and so on.

Lesson Study learning is a learning which connect fellow students that form learning community with learning each other and caring each other. The expression Lesson Study is a literal translation for the Japanese word *Jugyokenkyu*, *jugyo* means *lesson* and *kenkyu* means *study* or *research* (Fernandez, 2002). This learning is focused on the process of learning and the involvement of the students. By this learning will be created a living class where all the students actively participate in learning process. Effective instruction occur when students are actively involved in organizing and finding relationships in the information they encounter rather than being the passive recipients of teacher delivered bodies of knowledge. This activity results not only in increased instruction and retention of content but also in improved thinking skills (Eggen & Kauhack, 1996). Problem Based Learning is a way of constructing and

teaching course using problem as a stimulus and focus on student activity. Problem Based Learning is a learning model with a principle that problem can be used as beginning for reaching or for integrating a new knowledge (Boud & Felletti, 1991). Implementation of learning collaboration in learning process based on the finding that Lesson study is a professional development process that Japanese teachers engage in to systematically examine their practice. The goal of lesson study is to improve the effectiveness of the experiences that the teachers provide to their students (Fernandez, et all, 2001).

Based on the background, the writer identifies the problems that are:

There is no learning each other and caring each other among the students in learning process and less of involvement of student in teaching-learning process. Lesson study is a learning that focuses on student involvement that required to be applied in learning process of chemistry topic.

This research identifies the problems and limit only on the using of Problem Based Learning model based on Lesson Study can increase the student's achievement in salt hydrolysis topic in SMA N 15 Medan in science program in academic year 2014/2015. The problem statements of this research are:

Is the student's achievement by using PBL model based on Lesson Study is higher than using direct instruction model? And Is the student's generic ability in subject matter Inorganic metallic using PBL model based on Lesson Study improved?

The benefits of this research are: Learning based on Lesson Study will increase the colleague fellow teacher in order to be able to know how far the teacher teaching well and connection fellow students will form learning community with learning each other and caring each other.

## **B. LITERATURE STUDY**

### **1. Overview of the Study**

Effective instruction occur when students are actively involved in organizing and finding relationships in the information they encounter rather than being the passive recipients of teacher delivered bodies of knowledge. This activity results not only in increased instruction and retention of content but also in improved thinking skills (Eggen & Kauhack, 1996).

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## 2. Problem Based Learning Model

Learning model is entire combination of presentation of subject matter which includes all aspects before while and after of learning which done by teacher also all the facility which concerned that is used directly or indirectly in teaching-learning process (Istarani, 2011).

PBL is based on study result of Barrow and Tamblyn and first time is implemented at the medical school in McMaster University Canada in 1968. PBL as a learning approach is applied with the reason that PBL is very effective in medical school where the students is faced in a problem then demanded to solve it. Although the PBL is developed in medical school firstly, but then it is developed and applied in general learning (Barret, 2005).

Boud and Felletti (1991) said that, Problem Based Learning is a way of constructing and teaching course using problem as a stimulus and focus on student activity. The student are expected to have motivation to study, not only just listen and remember but also trained to explain their explorer to another and trained to solve the problem when they learn chemistry. Problem Based Learning is an educational approach whereby the problem is the starting point of the learning process (Graff & Kolmos, 2003). Gijsselaers defines PBL in relation to theoretical learning principles, such as learning as the construction of knowledge, meta-learning and contextual learning.

## 3. Lesson Study

On any given day thousands of college instructors enter similar classrooms to teach similar, if not identical, subjects. Despite similar pedagogical goals, approaches and experiences, teachers typically work alone when planning instructional activities and assignments. Such isolation limits efforts to improve college teaching on a broader scale, both within and across disciplines. Although individual teachers may reflect on and improve their practice, there are few occasions to converse with colleagues about what they discover about teaching and learning. When they do share their ideas about teaching, it likely takes the form of knowledge they develop from their experiences in the classroom. Although practitioner knowledge is immediately useful for the teacher, it tends to be tied to concrete and specific contexts (Hiebert, Gallimore, & Stigler, 2002).

One answer is *lesson study*, as Hiebert et al. (2002) suggest. Lesson study is a teaching improvement and knowledge building process that has origins in Japanese elementary education. In Japanese, Lesson study teachers work in small teams to plan, teach, observe, analyze, and refine individual class lessons, called research lessons. Nearly, all Japanese teachers participate in a lesson study team during a school year. In

addition, they observe research lessons regularly in their own schools and at schools that host lesson study open houses. Research lessons are published and widely disseminated throughout the country. In essence Japanese lesson study is a broad-based, teacher-led system for improvement of teaching and learning (Cerbin & Kopp, 2006).

The key steps in the process of lesson study are:

a. Formulating Learning Goals

Lesson study teams usually consist of 3-6 instructors from the same discipline although there could be interdisciplinary teams where begun by selecting a course, topic, and goals for student learning.

b. Designing the Research Lesson

The team creates a lesson intended to “bring the goals to life” (Lewis, 2000). They may modify an existing lesson or start anew. Teachers, who may be virtual novices or seasoned experts, share their previous experiences teaching the topic, and discuss possible ways to address the lesson goals. Planning a research lesson differs from everyday class preparation in several ways. An obvious difference is the degree to which teachers collaborate with one another in creating the lesson.

c. Designing the Study

The team develops a plan to investigate how students learn from the lesson. The plan specifies the type of evidence the team will collect and how observers will observe and record data during the lesson. Planning the study coincides with planning the lesson. As teams design the lesson they discuss what types of data they will collect as evidence of student learning and thinking.

d. Teaching and Observing the Research Lesson

The lesson is taught at the scheduled time during the term. One member of the team teaches the lesson and other members attend the class to collect data. Teams may also invite guest observers (e.g., departmental or professional colleagues, administrators, graduate students).

Instead of observing how the teacher teaches, as in typical classroom observations, observers focus on how student respond to the lesson, which was designed by the team rather than by the person who happens to be teaching. The lesson is videotaped or documented during the lesson, sometimes from multiple vantage points, for future reference and review.

e. Analyzing the Evidence

Soon after the lesson is taught the team holds a debriefing meeting to examine evidence related to the learning goals and to reflect in the experience. Participants

include the lesson study team members and guest observers. Participants share their observations and examine additional evidence from the lesson, such as student written work, searching for pattern that may reveal important insights into teaching practice and student learning.

f. Repeating the Process

Following the debriefing session, the lesson study team holds one or more meetings to organize and analyze the data further and discuss possible changes to the lesson and/or the study. Based on the evidence, the team revises its approach. In addition to revising the lesson and the method for collecting data, some teams reconsider their learning goal in light of the findings. During the second iteration, the lesson study team teaches the revised lesson in another class, usually the following term.

g. Documenting the Lesson Study

Teams document their lesson studies so that other instructor can review and learn from their work.

Lesson study is needed to do in Indonesia, because the efforts the increasing of quality of education which have done by government through the program of training of teacher, commonly just a limit to the increasing of matter comprehending, whereas the knowing of learning method is done separately from the lesson (Rahayu, P., dkk, 2012). The implementation of the learning needs the enough profesionalism of teacher. The teacher must be have the enough knowledge to give the knowledge well. Therefore, in the implementation of the knowledge is needed a facility of teacher in thinking share. A Lesson Study can be stated as one of way of teacher in thinking share in arrangement and development of lesson plan (Saidah, N., 2014).

#### 4. The Relevant Research

The relevant research is a description between the problem that researched with early researches which have done before this research. The relevant research can be used as a review and ale to help in discussion of research.

Research that composed by Ririn Eva Hidayati year 2012 with title “Penerapan Lesson Study pada Materi Hidrolisis Garam di MAN Denanyar Jombang” conclude that Lesson Study can increase the effectiveness of experiment in learning of Salt Hydrolysis. The result of research show that the ability of teacher in teaching learning is increase at first cycle 75% and second cycle 88%. The activity of students in discussion with teacher and with fellow student also increase each at first cycle 72% and 81%, and second cycle 83% and 91%. The different of the research that was done by Ririn is different with this

research that is Ririn more focus on the ability of teacher whereas in this research focus on the increasing of student's achievement.

The other relevant research is composed by Bagus Budiarto year 2010 with title "Implementasi Lesson Study pada Mata Pelajaran Fisika berbasis Problem Based Learning Materi Kinematika di SMA 1 Pematang Tahun 2010-2011". The result of the research show the percentage of average of comprehension of basic science of students at pre cycle 64.96%, cycle I 70.76%, and cycle II 74.03%. the comprehension of kinematic concept at pre cycle 65.81%, cycle I 68.38%, and cycle II 70.68%. The result shows that Lesson Study can increase the teacher quality and can increase the student's achievement. The research relevant to this research that uses Problem Based Learning based on Lesson Study.

## C. RESEARCH METHODOLOGY

### 1. Research Population and Sample

The population of this research is all of students grade XI at second semester. The students are in SMA N 15 Medan at academic year 2014/2015.

A sample in this research is divided into two classes in XI-Science second semester. XI-IPA 4 is as control class by using direct instruction model and XI-IPA 2 is as experiment class by using PBL model based on Lesson Study.

### 2. Research Design

The design of this research is conducted in two classes as sample where the first class is as control class and the second class is as experiment class. The design of this research is as shown in the table 1.

**Table1.** Research Design

Class	Pre-Test	Treatment	Post-Test
Control Class	$X_1$	$T_1$	$X_2$
Experiment Class	$X_1$	$T_2$	$X_2$

Where,  $X_1$  : pre-test  
 $X_2$  : post-test  
 $T_1$  : teaching-learning process by direct instruction model  
 $T_2$  : teaching-learning process by PBL model based on Lesson Study

### 3. Technique of Data Analysis

Techniques of data analysis that used are normalized gain, homogeneity test, normality test, and hypothesis testing.

#### a. Normalized Gain

According to Meltzer (in Sipayung, 2014) to calculate the student's achievement is applied formula gain normalization or g factor (gain score normalized). The formula that is used is formula 3.6.

$$g = \frac{\text{post test score} - \text{pre test score}}{\text{maximum score} - \text{pre test score}}$$

Where, the values of normalized gain are:

$$g < 0.3 \quad : \text{low}$$

$$0.3 \leq g < 0.7 \quad : \text{medium}$$

$$g \geq 0.7 \quad : \text{high}$$

The effectiveness of the model of teaching that used is calculated by formula 3.7.

$$\% \text{ Effectiveness} = \frac{\text{gain of experiment} - \text{gain of control}}{\text{gain of experiment}} \times 100\%$$

And the statistic hypotheses are:

$$H_a : \mu_1 > \mu_2$$

$$H_0 : \mu_1 \leq \mu_2$$

Where,  $\mu_1$  : the increasing of student's achievement by using PBL model based on Lesson Study in Salt Hydrolysis topic.

$\mu_2$  : the increasing of student's achievement by using direct instruction model in Salt Hydrolysis topic.

The hypothesis is testing by using t-test (Sudjana, 2002) formula :

$$t_{\text{count}} = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

## D. RESULT AND DISCUSSION

### 1. Research Result and Data Analysis

The instrument is used to measure the student's achievement that has been tested by validity test, difficulty level, discriminating index, and reliability test. The achievement is taken by calculating data of pre-test and post-test. the result of the both of test is analyzed by normality test, homogeneity test, normalized gain, hypothesis test, and normalized gain from both of class experiment and control class.

### 2. Analysis of Instrument

In this research, the validity of test is done by content validity and constructs validity. The construct validity was tested in class XII of SMA N 15 Medan and the amounts of students are 38 with 40 items of multiple choice questions. After analyzed obtained 26 items are valid and 14 items are invalid for  $n = 38$ ,  $r_{\text{table}} = 0.320$ .

The reliability test is used to measure if the instrument test gives the consistent result whenever the instrument is used to measure the student's achievement. The criterion of reliability test is if  $r_{\text{count}} > r_{\text{table}}$  at significant level  $= 0.05$ , so the item test is reliable. the result,  $0.8990 > 0.320$ , so the item of the instrument in this research is reliable.

### 3. Achievement of Research Result

The data that have been collected in this research, pre-test and post test, will be analyzed. The data is analyzed to know how the achievement of students in the teaching of Salt Hydrolysis by Problem Based Learning based on Lesson Study at SMA N 15 Medan compared with direct instruction model. The result of the student's achievement is shown in Table 2.

**Table 2.** Result of Student's Achievement

Class	Pre-test		Post-test	
	$\bar{X}$	S	$\bar{X}$	S
Experiment Class	35	8.98	79.73	10.20
Control Class	33.11	11.45	65.95	12.68

The data above shows that the average value of pre-test of experiment class (35) is higher than control class (33.11) and also the average value of post-test of experiment class (79.73) is higher than control class (65.95).

### 4. Normalized Gain of Research Data

Normalized gain is analyzed to know the student's achievement and how far the students understood the chemistry topic, Salt Hydrolysis. The data is obtained from pre-test and post-test data where the calculation is shown in Appendix 12.

The data of normalized gain is used to compare the student's achievement in both of class experiment and control class. The average value of normalized gain is shown in the Table 3.

**Table 3.** Average value of normalized gain

Class	Normalized Gain
Experiment Class	$0.695 \pm 0.14$
Control Class	$0.483 \pm 0.19$

## 5. Hypothesis

This testing is used to analyze the alternative hypothesis ( $H_a$ ) and nil hypothesis ( $H_0$ ) is received or refused. The hypothesis is tested by t-test one tail from the average of normalized gain from both of class. The calculation of the hypothesis is shown in Appendix 16. The result of the hypothesis is in the Table 4.

**Table 4.** Result of hypothesis testing

Class	Average and Standard Deviation	$t_{\text{count}}$	$t_{\text{table}}$		df	Description
Experiment	0.6947±0.1349	5.1985	1.6684	0.05	72	$H_a$ is accepted and $H_0$ is refused
Control	0.4825±0.1861					

From the table above show that the value of  $t_{\text{count}}$  (5.1985) >  $t_{\text{table}}$  (1.6684), so  $H_a$  is accepted and  $H_0$  is refused. This means that the student's achievement that taught by PBL model based on Lesson Study is higher than taught by direct instruction model in Salt Hydrolysis topic

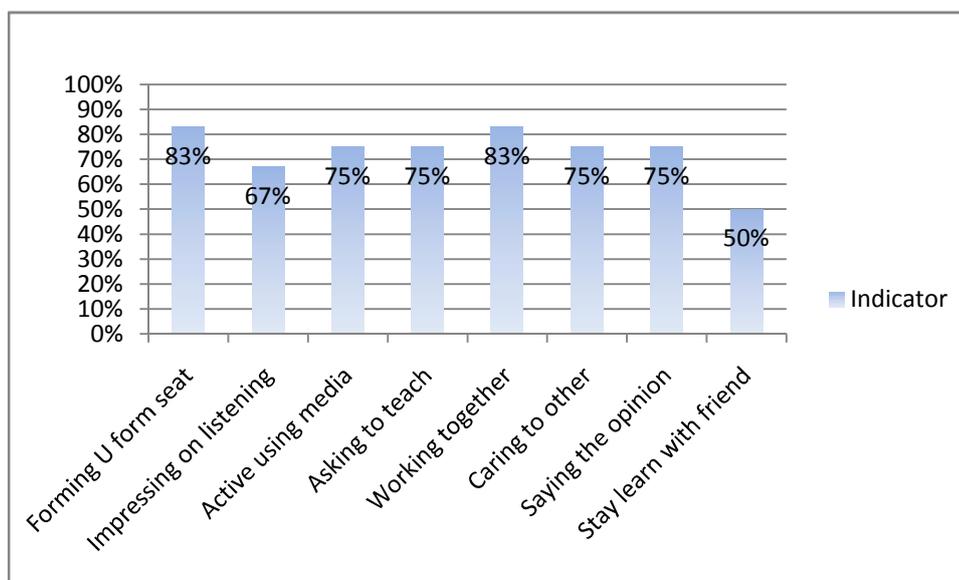
## 6. Observation Sheet Result

The result of observation sheet show that the learning process based on Lesson Study in this research is obtained that the students are less in stay learn with friend and just 50% of the students that stay learn with their friends. While there are 83.3% of students that working together in "U" form seat. The graph of observation sheet of Lesson Study is shown in Figure 1.

## 7. Discussion

The research that done with learning process by PBL model based on Lesson Study prove the effectiveness of the model to increase student's achievement about Salt Hydrolysis. The effectiveness of the model that used is obtained data from calculation of gain of experiment and control is 30.54%. Students learned each other and caring each other in solving the problem that was given. In guidance of teacher, the students working together in group and helping each other fellow of students. Through this learning model decrease the bullying of friend fellow student and make the students caring each other and if their friend fellow of them is nit understand about the topic active to ask their friend also their teacher then the teacher come to the group to explain or to help the solving problem. The "U" form of seat make each other among the students to be closer and easy

in learn and also the teacher easier to observe the students and easier to achieve all of the students. Its different with direct instructional model, teacher must walk around the students among some line of tables. The students less active with their friend and tend to listen to the teacher. And finally this learning model makes the students pretend to understand.



**Figure 1. Score of Observation Sheet**

Based on the relevant research that was done by Ririn year 2012, the activity of student with teacher and student with fellow student, the result each is first cycle 72% and 81%, and second cycle 83% and 91%. In this research is obtained the activity of student with teacher at first cycle is 50%, second cycle 75%, and third cycle is 100%, and the activity of student with fellow student at first cycle is 75%, second cycle is 75%, and third cycle is 100%. The using of this model on learning from first meeting to last meeting is increase in Salt Hydrolysis topic. The result of the observation sheet show that the students are be less in stay learn with friend (50%). The students choose to ask the teacher directly, so it made the students active in asking (75%). But, the student still work together with their fellow students (83%) in “U” form seat (83%). This result prove that Lesson Study has an influence in achievement of the students.

## **E. CONCLUSION**

Based on analysis and discussion of data, this research can be concluded that the student’s achievement in Salt Hydrolysis topic using PBL model based on Lesson Study is higher than using direct instruction model. The student’s achievement is obtained from data of post-test and data of gain in both of class. In experiment class, using PBL model based on Lesson Study, the value of post-test is 79.73 and gain is 0.695. The student’s

achievement that gotten is proved by statistical hypothesis testing, one tail t-test. Based on the criterion, it is obtained that the value of  $t_{\text{count}} 5.1985$  is higher than  $t_{\text{table}} 1.6684$ . It prove that  $H_a$  is accepted and  $H_0$  is refused, so, the student's achievement using PBL model based on Lesson Study is higher than using direct instruction model.

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